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CIVIL WAR RAILROADS: A REVOLUTION IN MOBILITY

BY

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ABSTRACT

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The Civil War pitted two armies against each other on a grand battlefield in the East that focused on Virginia and its Border States and an equally demanding battlefield in the West for control of the Mississippi River. Both sides faced the extremely difficult challenges associated with defending key terrain and the need to seize the initiative through offensive maneuvering and engagement. Limited manpower and the operational ambiguities caused by movement (or deployment) to several locations on an ever-changing battlefield caused railroad usage to become a matter of military readiness and national security for both sides. This paper provides a brief review of railroad capabilities of the United States before the Civil War, elaborates on the railroad capabilities and usage of both sides during the war, and discusses instances where the effective use of railroad mobility was the decisive factor in the outcome of the battle. Lastly, provides an examination of the impact of railroad mobility on the Civil War and warfare.

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PREFACE

The author is indebted to the many people and organizations that helped make this project possible. I especially appreciate the assistance of the Army Military History Institute and encouragement and support of the United States Army War College faculty. I am particularly grateful to Colonel (Ret) Thomas Sweeney for his tireless mentorship. Finally, this work as with most major projects could not have been possible without the support of my wife Andrea and sons.

CIVIL WAR RAILROADS: A REVOLUTION IN MOBILITY

When the Civil War erupted, there was no plan or strategy for restoring the Union. No leader on either side had experience commanding large fielded forces in the manner that would become the norm in this war. In the beginning the Confederate forces appeared to have the advantage, but that changed as the North became better at employing its numerically superior force and flexed its considerable industrial might. Also, the character of the war changed as innovations from industry were introduced to the battlefield. An innovation, in its simplest form, is the combination of new "things" with new "ways" to carry out tasks.[1] The melding of the emerging commercial railroad industry into the war effort is an example of how a technological innovation such as this one in the transport of personnel and cargo can influence the execution and outcome of the warfare. Innovations themselves do not bring about change. Change occurs only after applying resources, accepting risks, and providing leadership.

The railroad presented itself as a significant innovation to warfare for both the North and the South but their experiences and outcome were startlingly different. The Civil War was the first notable military conflict in which the railroad was available for the large-scale movement of troops and sustainment. In fact, the Civil War has been called the "first real railroad war."[2] Initially most of the military leadership in the North and the South were slow to grasp the value of the railroad to military operations. As the war progressed railroads became major military targets and often influenced the outcome of battles or campaigns by providing the ability move reinforcements, rations, or ammunition to critical points. At the end of the war, the North possessed an efficient and interoperable railroad system, while in the South poor management and wreckage from military targeting rendered the Southern railroad industry impotent. This study looks at the use of railroads in the Civil War in the following segments: The development of the railroad industry in the years before the Civil War. The leadership and administration of railroads provided by the North. The leadership and administration of railroads provided by the Confederacy. Railroad mobility provides a decisive factor in the Civil War. The contributions and legacies to warfare provided by the railroads during the Civil War.

RAILROAD INDUSTRY AND INFRASTRUCTURE DEVELOPMENT IN THE YEARS BEFORE THE CIVIL WAR

Although railroads were of vital importance during the Civil War, the railroad industry was only in the early phase of its development. The first chartered railroad to operate in the United States, the Baltimore and Ohio, began passenger and cargo movement in May 1830 using horses to pull the cars.[3] Later in the year, the first steam-powered train began operation

in South Carolina and by the end of the year there were 23 miles of railway track in the United States.[4] Locomotives and rolling stock developed rapidly changing from stagecoach cars pulled by small steam engines to large passenger and cargo railcars pulled by powerful locomotives. The magnetic telegraph to railways was the first major improvement in dispatching trains and introduced an element of promptness and safety to railroad operations.[5] Railroads were visible symbols of the Industrial Revolution in the United States.

The effects and benefits of the Industrial Revolution were most evident in the North. In 1860, the population of the United States was almost 35 million with 22 million in the North, and 13 million in the South, of which 4 million were slaves.[6] The South with a smaller population was primarily engaged in agriculture, while the North had developed a diverse industrial base supported by a solid financial system. The North developed a relatively dense rail and waterway network to support its industrial base and product distribution. The South focused its railroad industry on the movement of agricultural products from farms to ocean or river ports for transshipment to manufacturing centers in the North or Europe.[7]

In the decade before the war, there was a huge expansion of the railroad industry in the United States. Most of the construction in the North was a result of competition between the major railroad companies of New York, Pennsylvania, and Ohio to create rail links to the emerging markets in the mid-west. In the 1850's railway building took a phenomenal spurt; 4000 miles were built east of Pittsburgh and 7,500 miles were built in the rich Northwest.[8] By the beginning of the war, Northern railroads had matured a credible east to west passenger and cargo movement capability and were steadily pushing Northern industry and finance westward. When combined with the information link established by the telegraph, a strong commercial and social bond was emerging between the North and West.

Conversely, Southern railroads were small hub and spoke operations with a port or city functioning as the hub and a single or several agricultural areas acting as the spokes. Each railroad company operated independently and generally avoided connection with competing companies. The Southern railroads were primarily dedicated to freight movement and often in alliance with large shipping companies. Passenger travel though possible was not convenient and little effort was made to develop this capability. Additionally, Southern railroads were more influenced by state governments and external investments for financing construction and infrastructure than their Northern counterparts. Even with the addition of over 5000 miles of railway in decade from 1850 to 1860, the collective railroads of the South did not constitute a railroad system.[9]

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The growth and development of the railroad industry did not mean that the different railroads were interoperable. Each railroad company determined its own track gauge, which in many cases meant that one company's locomotive and railcars, might not fit another company's track. Track gauge ranged from the European standard of 4 feet 8.5 inches to 6 feet, which prevented the exchange of rolling stock and the throughput of cargo from one line to the next.[10] In 1861, 62 percent of the total mileage in the United States was 4 feet 8.5 inch to 4 feet 10 inch gauge, followed by 22 percent being 5 foot gauge, the remaining 16 percent ranging from 5 feet 4 inch to 6 foot.[11] In most cases long-distance freight had to be handled by several railroad companies to reach its destination. However, by 1850 many railroad companies in the North such as the Baltimore and Ohio, Erie, and the Boston and Albany were advocating connection of railways to propel their growth west of the Alleghenies.[12] The joining of tracks belonging to two or more railroad companies at a common point was simple, as long as the gauge was the same. Both the North and South were to enact legislation soon after the war began to do this simple integration, often over the strong objections of railroad companies, and local and state governments. The war accelerated integration, but only the essential connections would be possible during the war.

From 1850 through 1860 the railroad industry was the largest growth industry in the nation laying some 26,300 miles of new track and building or purchasing about 3,800 locomotives, 6,400 passenger and baggage cars, and 88,600 freight cars.[13] Most rail was rolled wrought iron "T" section, but rail iron was normally the poorest quality iron. Additionally, some Southern railroads constructed track and sidings made of an iron strap affixed to a wooden "stringer" rather than solid iron rail. These light wooden "stringer" rails restricted the capacity of these railways.[14] Most rail was spiked directly to untreated ties and laid in roadbeds with poor ballast. Bridges were hastily constructed with light material.

The quality and gradient of the track normally governed train speed. Freight trains in the North, usually averaged from 11-20 miles per hour while the passenger trains traveled at speeds over 30 miles per hour. Trains in the South seldom traveled faster than 25 miles per hour.[15] All locomotives in the South and most in the North burned wood. Some railroad companies in the North had also begun to experiment with coal as an alternative fuel. Many engines could use either fuel interchangeably, and, generally speaking, a cord of wood and a ton of coal produced about the same amount of locomotive power.[16]

Rolling stock was normally made of wood with cast iron car-wheels and joined by link and pin couplers.[17] Hand-operated brakes were used in rail yards and on siding, but when joined to a train only the locomotive had brakes. Passenger cars had open vestibules at each

end and could normally seat about 50 people. Various models of freight cars – box, gondola, cattle, flat, dump, rack and coal – were in use by most companies.[18].

Almost all locomotive and rolling stock manufacturers were in the major cities of North such as Philadelphia, Baltimore, and New York.[19] Maintenance personnel and inventories of equipment repair parts, and supplies were substantial in railroad companies in the North. Railroad companies in the South imported most of their rolling stock, rail, tools and repair parts from the North or Europe. Inventories were small and were depleted almost immediately after the war began. The few manufacturers capable of building locomotives, cars or rails also manufactured weapons and other military equipment and were seldom employed to produce railroad equipment.[20] Neither side began the war with sufficient storage facilities, engine houses, machine shops, interchange yards, sidings, loading areas, and terminals. The North was in much better condition than the South and was more financially capable to surge to meet wartime requirements.

Northern railroads were superior in every aspect to those in the South and by 1861 the North had 22,400 miles of track while the South had only 8,700 miles of track.[21] Nonetheless, Southern railroads provided the Confederacy a tremendous capability to moving troops and supplies from one battle to another capitalizing on the South's tenuous interior position, which represented a definite advantage for a smaller country defending itself against a larger and more capable opponent.[22] As the war began, field commanders on both sides found capitalizing on the strengths of their perspective railroad capability extremely difficult. They were confronted with an untested and undocumented mobility capability and were learning how to manage and exploit its capability, largely by trial and error. Warfare had a new and important innovation that allowed for the rapid concentration of troops at new strategic points and lines of operation.

LEADERSHIP AND ADMINSTRATION OF THE RAILROAD OF THE NORTH

Even though the North possessed the better railroad infrastructure at the beginning of the war, corruption and mismanagement in the War Department negated this clear advantage in the first year of the war. President Lincoln's first Secretary of War, Simon Cameron, was a Pennsylvania politician appointed primarily for his support during the Republican Convention of 1860.[23] Secretary Cameron was a vocal advocate for development of the railroad industry and had large personal investments in a Pennsylvania railroad company. When the war began, he personally directed all matters pertaining to the rail transportation of troops and equipment. During the mobilization of units, he created an adhoc staff of political appointees to coordinate

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supply and transportation functions instead of using the existing Quartermaster Department under the leadership of the Colonel Montgomery C. Meigs.[24] One of their more destabilizing practices was to use brokers for obtaining rail transportation instead of seeking competitive rates and contracts.[25] These actions coupled with Secretary Cameron routing troops out of their way in order for them to transit his Pennsylvania railroad company created the first railroad and military scandal.

Seeing that regulation of the railroad industry would be necessary, Congress passed the Railways and Telegraph Act in January 1862. The law gave the Federal government the ability to impress or seize as necessary railroad and telegraph systems it required, including those in the South, and established the United States Military Railroad System.[26] The military was provided unimpeded use of the railroads at a predetermined and reasonable rate of payment. The Military Railroad Service did not as a rule take over operation of commercial railroad companies. It did however, operate those railroad companies captured by the Union armies in the war zone.[27] The regulated private companies and the military operated lines became a nation wide system, which became more efficient and more interoperable over time.

The confusion of the early mobilization and assertions of corruption prompted the Congress to investigate Secretary Cameron and the War Department. Soon after the investigation began, President Lincoln replaced Secretary Cameron, with Edwin M. Stanton whose experience with the railroad industry was as an attorney for an Illinois railroad company. Rather than personally manage the federalized railroad system, Stanton charged Colonel Meigs and the Quartermaster Department to control railroad transportation.[28] In February 1862, Daniel C. McCallum was appointed as director and superintendent of the military railroad. Superintendent McCallum had experience with the New York and Erie Railroad and was an excellent railroad manager who brought discipline and efficiency to that portion of the railroad industry dedicated to the war effort and to the operation of the Military Railroad Service in the war zone.[29]

McCallum organized the Military Railroad into two divisions: the Military Railroad Service, which managed train movements and conducted general maintenance of the track and equipment and the Construction Corps which did major repairs and built new roadbed and bridges when necessary.[30] In late 1861, the Military Railroad Service located its headquarters at the former company headquarters of the Orange and Alexandria Railroad in Alexandria Virginia.[31] The Military Railroad Service operated all railroads in the war zone and captured Southern railroad companies. By the end of the war, the Military Railroad Service had exclusive control of over 2,105 miles of track and 22,000 men. The Military Railroad controlled 611 miles

of track in Virginia, Maryland and Pennsylvania; 1201 miles of track in Kentucky, Tennessee, Georgia, Mississippi, and Arkansas; and 293 miles in North Carolina. Seventeen thousand men supported the railroad in the west while 5000 men were dedicated to Virginia and North Carolina. [32]

The other division, the Railroad Construction Corps, maintained the railway and made major repairs to roadbeds and bridges when necessary. Tracks were routinely torn up, bridges were burned, and equipment derailed and demolished. To lead this effort, Herman Haupt, a West Point graduate and railroad construction engineer was appointed as the chief of construction and transportation for the Military Railroad.[33] Haupt brought extensive experience in railroad construction and tremendous skills as a problem solver and organizer. He was instrumental in the organization of the Construction Corps, which by the summer of 1862 consisted of about 300 men, divided into ten man squads, two squads per officer.[34] The Construction Corps later enlarged to include a bridge building department, and eventually was engaged in constructing freight cars, barracks, wharves, warehouses, engine-houses, and all of the other functions necessary to maintain a railroad operating in a war zone.[35]

Haupt's first assignment was to rebuild a three-mile section of track near Belle Plain, Virginia, a part of the Richmond, Fredericksburg, and Potomac Railroad, which had, been destroyed by retreating Confederate Forces. Using a work force with little experience in laying track and hindered by bad weather, Haupt was able to repair this track in three days. After Belle Plain, he supervised the complete repair of the damaged 150-foot Pohick Creek Bridge returning the bridge to full service in less than 24 hours.[36] Haupt supervised the restoration of the ninety feet high and four hundred feet long span over the Potomac Creek. Using green timber from nearby forest and troop labor, the span was completed and in operation in less than ten days.[37]

Often difficult to work with, Haupt was routinely in conflict with military leadership over the operation of the railroad. Haupt protested to Secretary Stanton whenever he believed that his authority was contested or in conflict with a field commander. Though McCallum nominally was Haupt's superior, an informal arrangement was readily made that prevented any quarrelling. "McCallum to the office and I took the field," was the way Haupt put it.[38] At one point, Haupt resigned rather than submit to orders that he believed to be detrimental to the rail service. After a short period, he was asked to return, but did so only after the government issued Order No 23. This order provided Haupt with what authority he believed essential to the efficient operation of the railroad[39]. For the transporting supplies on the Military Railroad, Haupt established these priorities: (1) subsistence for men in the field; (2) forage for horses; (3) ammunition; (4) hospital

supplies, and (5) troop units.[40] Additionally, Haupt ensured that the trains ran on schedule. Haupt also worked endlessly to get the correct supplies forward at the right time and to get railroad cars unloaded, returned promptly, and not used for storage. His strict procedures instilled a needed discipline in Union supply procedures in the first year of the war.[41]

The ability of the Construction Corps to repair damaged railroads dramatically improved as the war progressed and later in the war it ability became a combat multiplier. Haupt devised a method for prefabricating bridge parts and trestles, which could later be assembled at the site of a destroyed bridge. The bridge parts were constructed at the Orange and Alexandria rail yard and sent out in packages according to the size of bridge to be replaced.[42] This innovation reduced the time the construction crews would have to spend on site and also ensured that the replacement bridge was built of quality materials. By the end of the war, the Construction Corps numbered more than twenty four thousand civilian workers and had laid or relaid 641 miles of track and built or rebuilt 137,418 feet of bridge.[43]

Other innovations associated with Union railroad operations were the introduction of the armored railroad car, the ambulance car and the hospital train. In 1862, armored railroad cars were introduced when a bulletproof car with cannon was developed for use by the Army of the Rappahannock.[44] Armored railcars, usually positioned in front of the locomotive, provided an enhanced defensive capability for railroad operations and also provided the combat commander and offensive capability when engaging targets in proximity to the railway. Armored cars were outfitted with weapons such as revolving rifled guns, mortars, and an 8-inch rifle with a range up to 1½ mile, and in some cases naval howitzers.[45]

The North also introduced the ambulance car and hospital trains. Beginning in 1862, the United States Sanitary Commission oversaw the development of special cars and trains specifically for medical care and evacuation. Normally, at least one medical support railcar moved almost daily between major supply points and the forward location of the field armies. In 1863, a complete hospital train was introduced on the Orange & Alexandria Railroad, converted from passenger coaches, and with a capacity of over 500 patients. The train contained special cars for the surgical staff, for a dispensary, storeroom and kitchen and ten ward cars, each with accommodations for thirty patients. A sliding door was installed on both sides of each car to allow for the loading of litters. The locomotive stacks, cab, and tender were painted red and at night ran with 3 red lights above the headlight to distinguish it from other trains.[46] After the battle of Chancellorsville, 9000 wounded were transported to Aquia Creek in two days. In twenty days following the battle of Gettysburg, over 15,000 wounded were distributed to hospitals in Washington, Harrisburg, Philadelphia and New York.[47]

Northern railroad companies prospered under the Railways and Telegraph Act. While few railroad companies were able to increase infrastructure or rolling stock during the war, most operated at an efficiency level, which was sometimes twice their pre-war capacity. Although often sited as difficult and demanding, leaders such as Haupt from the Pennsylvania Railroad and McCallum from the Erie Railroad possessed the experience, knowledge, and drive to provide the North with a superior and more capable railroad. Their leadership and the structured relationship they forged between the private railroad industry and the military railroad significantly contributed to the ultimate victory of the North.

LEADERSHIP AND ADMINISTRATION OF THE RAILROAD OF THE SOUTH

From the very beginning the railroad and telegraph industry would prove to be at the center of the struggle between the North and South. In both, the Confederacy was far inferior to its enemy. President Jefferson Davis moved quickly after assuming office to create a War Department similar in design to the office that he had overseen as Secretary of War for the United States. However, the states in the South, which had just seceded from the United States, were opposed to integration of state resources or centralized control by Davis' government. Southern railroad companies and most other businesses were also opposed to any loss in private control and management.[48] The reluctance of the Confederate government to control and leverage its limited resources over time would cause it to resort to much less and less acceptable measures to meet the ever increasing logistics demands of the war effort.

President Davis appointed William Ashe, president of the Wilmington and Weldon Railroad as an assistant quartermaster and Superintendent of Railroads.[49] Ashe was the first of a series of appointees who attempted to enact efficiencies and to centralize the railroad capability in the South without success. Even limited regulation of the railroad was difficult in the first years of the war. A state, county, or city's interest in some way influenced nearly every railroad company and when combined with the competitive environment of the industry, finding acceptable practices and procedures eluded the government.[50]

One of Ashe's first challenges was to connect Southern Railroads in a manner to allow the Confederacy to capitalize on interior lines of communications. Large gaps prevented even a loose network and mismatched gauges hampered continuous movement. One of the most glaring gaps in the lines was a forty-mile stretch between Danville, Virginia and Greensboro, North Carolina, which would provide a relatively secure line into the heart of the Confederacy. President Davis designated the closing of this gap to be of military necessity in 1861, but some Confederate leaders protested the project as a violation of state rights and instead of completing

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the road in six months, its construction took over two years. Other similarly important connections were designated for immediate construction, but construction never began because the Confederate Congress stalled every effort that appeared to diminish the state rights.[51] The failure to connect these railroads limited the advantage Confederate commanders should have had with interior lines of communication. Ashe was also unable to provide assistance to railroad companies in obtaining repair parts, rolling stock, locomotives, and railroad iron.[52]

In 1862, Ashe resigned to a combat command and was replaced by William M. Wadley, the former president of the New Orleans, Jackson and Great Northern Railroad, later in the year.[53] Wadley was a well-known railroad expert and also attempted to gain greater control over the fiercely independent and divided railroad industry. In 1863, the result of his efforts was the passage of a strong railroad law by the Confederate Congress, which created a centralized railroad system. The law handed over to the Quartermaster General the management of all railroad equipment with the exception of one train on each line. Any railroad refusing to submit to this control might be seized and impressed under the provisions of the Impressment Act.[54] However, Wadley was removed from office before implementation of the law and his assistant, Lieutenant Colonel Frederick M. Sims, was charged with leading the newly formed Railroad Bureau.[55] Almost immediately falling back on its previous aversion to infringing on states rights and the inability of the railroad industry to come to terms on the exchange of rolling stock, the government failed to implement the law. Sims was confronted with rapidly deteriorating railroad system with few resources.

Southern railroad companies did however attempt to provide credible service to the Confederacy.[56] When the war began railroad companies gave the government special rates for carrying troops and equipment and a few offered to carry soldiers for free. Even as inflation increased the price of fuel and materials, railroad companies attempted maintain the low rate charged to the government and as a result the public was forced to pay higher rates. Railroads became exceedingly unpopular with the public and were accused of profiteering. It was inevitable that the railroad would be forced to increase their rates to remain in business. By 1863 clerical service wages of the South Carolina Railroad for example had advanced 100 percent, unskilled labor 150 percent, mechanical labor 200 percent and equipment costs had increased 2,000 percent. Dividend rates as well as receipts increased, but as in the case of South Carolina Railroad where the increase was from 7 percent to 16 percent in 1864, the gold value of money decreased at a greater ratio, being 38 to 1 by the end of 1864.[57] Inflation, the high costs of fuel, labor, and repair parts compounded by the lack of a reasonable and standard billing rate, a universal service contract, and effective government regulation, rendered

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Confederate railroad more and more ineffective to field commanders and the general population.

The South's ability to maintain its railroad industry was further hampered when the government preempted all foundries and iron manufacturers for military purposes. Though railroad irons could be rolled in the Confederacy there was a serious shortage. Railroad companies had to resort to cannibalization of minor rail lines to repair main rail lines.[58] These practices gradually reduced the railroad's ability to provide service to all pre-war areas and also reduced the overall ability of the South to cross-level critical resources. Southern railroad capability grew progressively worse, with broken rails, flat wheels, rotten crossties, old powerless engines, and ramshackle cars. Accidents became more frequent as rails broke and equipment became dilapidated.[59] Additionally, the Confederates themselves destroyed some of the companies with pre-war ties to Northern railroad companies on the grounds that the enemy tainted them.[60]

With each passing year of war, Union attacks on the Southern railroads became more effective. Both sides knew that the most effective way to stop a train was not a frontal attack, but to destroy the tracks or bridges and to a lesser degree disable the telegraph line. Invading armies tore up hundreds of miles of track, heating the rails and wrapping them corkscrew fashion around trees to prevent future use.[61] The loss of a bridge over a major river could stop rail movement for weeks and if severe maybe permanently. A particularly damaging example of such an incident occurred when General Joseph E. Johnston abandoned ninety locomotives and several hundred cars due to a damaged bridge during the retreat from Vicksburg. President Davis declared that the Confederacy "never recovered from the injury to the transportation service occasioned by the failure on his part."[62]

Southern railroads never played the part that could have been expected of them if the government had exercised proper control in the beginning. Food was in one place and the mouths to feed in another all the while transportation less able to connect the two. The inability of the Confederate government to mobilize and sustain the railroad industry contributed to the decline and eventual collapse of the Confederacy. The longer the war progressed Southern railroad companies were able to provide less and less and at the end could only provide point to point movement on select lines.[63]

RAILROAD MOBILITY; A DECISIVE FACTOR IN THE CIVIL WAR

In previous wars, it was common for battles to be fought over control of rivers, harbors, farmlands, and industry. In the Civil War, for the first time, battles were fought for control of the

railroads. Field commanders employed denial tactics, particularly when moving from one engagement to another or when in retreat. Railroads, which could be used by the enemy for advancement or support, were routinely destroyed. Tracks and roadbeds were ripped up, bridges and terminals burned, and all equipment and rolling stock that could not be moved out of the war zone were destroyed on site. On the other hand field commanders also sought to protect their own railroad capability to facilitate the movement of troops and supplies.[64] Railroad junctions and terminals were often the sites of major engagements.

During the first major engagement of the war, the Confederates established a pattern for using their railroads, which would be repeated over and over. Confederate General Joseph Johnston commanded over 12, 000 men positioned in the Shenandoah Valley, while General P.G.T. Beauregard maintained a defensive position surrounding the Confederate major supply depots at Manassas Junction also with a force of 12,000 men. A Union army of 35, 000 men under the command of General Irvin McDowell was south of Washington and General Robert Patterson was in command of an 18,000-man army near Harper's Ferry, Virginia. The primary objective of McDowell's army was to seize and deny the Confederates access to the railroad lines at Manassas Junction. Thus the control of a major railroad crossing became of strategic and tactical importance to the North and South beginning with the first battle. While the Union army marched into position, Johnston rapidly withdrew his army from the Shenandoah Valley and conducted a large scale movement by train across the Blue Ridge Mountains to Manassas Junction, thereby avoiding an engagement with Patterson's army moving from Harper's Ferry to the Shenandoah Valley. Johnston's army arrived at Manassas Junction in time to reinforce Beauregard and to turn the tide of the battle to the Confederacy's favor.[65] The South's first attempt at strategic mobility using the railroad was extremely successful. This first battle at Bull Run demonstrated the importance that control and protection of supporting railroads would become to both sides.[66]

Union General George McClellan expanded the war zone to southern Virginia as he attempted to flank the Confederate army by transporting an army of over 100, 000 men with supporting equipment by sea to the Virginia peninsula and attack to Richmond from the south. Part of McClellan's army deploying by sea was a small military railroad unit consisting of 5 locomotives and 80 boxcars, which was to operate on the Richmond-York River Railroad providing a continuous line of communications from Hampton Roads to Richmond. This sea movement represented the first military deployment of a railroad unit.

In the subsequent engagements, Lee directed General Jackson to move his army from the Shenandoah Valley by rail to join his army near Richmond.[67] Jackson moved his army on

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the Virginia Central Railroad from Charlottesville with only a single track and 200 railcars, but arrived too late on 26 June 1862 to attack McClellan's right flank. However he was able to inflict considerable damage on his secondary objective the York River Railroad. Using Cavalry to attack, obstruct, and harasses the Union controlled railroad, Jackson and Lee ensured that Union field commanders would no longer feel secure or be complacent with the protection of their supporting railroads. Even though the Union army won the battles at Fraser's Farm and Malvern Hill, McClellan retreated and transferred his operations to Harrrison's Landing which allowed logistics support using the James River instead of the railroad from Hampton Roads. McClellan's retreat required the abandonment of the supply stockpiles, ammunition, and railroad equipment. Some of the destruction was done by running full trainloads of supplies into the Chickahominy River to deny the Confederacy the railroad equipment.[68]

Also in 1862, Southern railroads conducted a strategic movement of an army. The first theater to theater movement of the war was the movement of General Braxton Bragg's Army of Tennessee from Tupelo, Mississippi to Chattanooga, Tennessee. While the cross country distance between these two cities is only 275, the only viable route on Confederate controlled railroads was 900 miles and required first traveling south to Mobile, Alabama before heading eastward to Chattanooga. The artillery and Cavalry marched over land while the Infantry moved by rail, which included a 20-mile water ferry transfer near Mobile. The first Infantry train reached Chattanooga in eight days and all arrived ahead of the Artillery and Cavalry.[69] The Confederacy's effective use of the telegraph and railroad to carry out strategic concentration resulted in their generals keeping troops near railroads and ready to move should the telegraph bring the call.[70]

The first major break in the South's loose railroad network was at the important railway junction at Corinth, Mississippi. The Memphis & Charleston Railroad running from Corinth to Chattanooga bisects the Mobile & Ohio Railroad running north to Columbus Kentucky and south to Mobile at Corinth. The Memphis & Charleston Railroad was the only trans-Confederate railroad and was considered so significant that its was referred to as the "vertebrae of the Confederacy" and "must be defended at all hazards."[71] The Confederate surrender of its defensive outposts Forts Henry and Donelson exposed the whole line of the Memphis & Charleston Railroad from Memphis to Chattanooga. The Union wanted to control of the railroad junction because holding it effectively cut off supplies to the western and southern parts of the Confederacy. General U.S. Grant remarked that Corinth held "the great strategic position of the West between the Tennessee and Mississippi Rivers and between Nashville and Vicksburg."[72] The battle for control of the railroad junction at Corinth was one of the bloodiest battles in the

first half of the war, but ironically railroads played no direct role in the battle. The forces that engaged over the railroad junction either marched in on foot or arrived by horse.[73] After two days of fighting, with thousands of causalities on each side, the Confederates fell back to Tupelo, some 50 miles south on the Mobile & Ohio Railroad.[74] With the loss of Corinth, the South's westward link was now a series of non-connecting lines, which was much slower and nearly twice as long.[75]

By late 1863, railroads provided a strategic movement capability and had evolved into the main supply arteries of the war machine of both sides though the capacity of Confederate railroads was in steady decline. During a lull in the East following the battle of Gettysburg, General James Longstreet's Corps was transferred from Virginia to Tennessee to join General Bragg's army in its contest with Union forces under General William S. Rosecrans for possession of the important rail junction of Chattanooga. The move involved two divisions with supporting artillery. The distance was 835 miles via Weldon, North Carolina, Augusta and Atlanta, Georgia over single-track of differing gauges that did not physically connect. One unit covered the distance in 7 days, 10 hours while most needed 8 to 10 days. The corps arrived in time to take a decisive part in the outcome of the battle of Chickamauga.[76]

The Union soon after conducted its own strategic movement to counter the Confederate victory at Chickamauga and subsequent siege of Chattanooga and Rosencran's army. Demonstrating the maturity and strength of its supply and railroad transport capability, General Joseph Hooker's Corps was transported from Alexandria, Virginia to Alabama by rail and then marched to Chattanooga to relieve Rosecrans. It was at that time the largest continuous movement of troops – over 23,000 men -- and supplies over 1200 miles of rail. And for the first time, each regiment traveled in a unit set with its own supplies, artillery, weapons, ammunition and horses, which facilitated its rapid movement into battle.[77] Within eight days the majority of Hooker's corps had traveled halfway across the nation and was prepared to relieve the siege on the Army of the Cumberland at Chattanooga. Even more remarkable, the railroad equipment was returned quickly to their assigned railroads and all lines resumed normal operations.[78] The deployment methodology developed and tested in this rail movement would serve as guiding principles for future wars.

On November 1864, General William T. Sherman was given the task to exploit the weakening of the Confederacy after the defeat of the Confederates at Chattanooga by seizing the vital railway junction and manufacturing center of Atlanta, as the first step in an advance to the sea.[79] Atlanta was second only to Richmond in importance to the Confederacy and was a strategic military objective for the Union. Sherman's campaign to seize Atlanta is often called "a

march," but technically during the Atlanta part of the campaign most of logistical support and troop movement was done on inland waterways and the connecting of several uncertain railroad lines. Supplies moved from Louisville through Nashville to Chattanooga traveling 340 miles. The most uncertain line was the 150 miles of single track from Chattanooga to Atlanta which required significant repairs to recover from damage inflicted by the retreating Confederate force under Confederate General Joseph E. Johnston. The 100,000 man Union army required the Military Railroad Service to deliver 1,600 tons of supplies and equipment daily in 10 trainloads of 160 tons each, made up of 16 cars with an average railcar load of 10 tons.[80] Sherman was certain that it would require the commitment of an enemy army behind him to disrupt his lines of communication for long; the burning of bridges and breaking of track by cavalry and guerrilla raids would only cause short delays in railroad operations.[81]

As Sherman closed on Atlanta, Johnston withdrew to hasty defensive positions across the Chattahoochee River, burning the bridges and destroying the track as he retreated. The railway dictated the axes of Johnston's retreat, the siting of defensive positions and the location of battles. Johnston's strategy as he withdrew in front of Sherman's advance was dominated by the railway from Atlanta, which was his lifeline. Although he fought a series of masterful withdrawal battles, he was like a diver on the end of a long airline. He had to react to any threat to cut it. Every time Sherman hooked round one of his blocking positions, Johnston was forced to withdraw to counter the move.[82] Johnston was as hamstrung by his tenuous railroad line of communication as he was supported by it. President Davis, desiring that the battle for Atlanta be fought more aggressively, replaced Johnston with General John B. Hood. Hood immediately withdrew from his defensive positions to engage Sherman and was driven into the fortified positions surrounding the city. As Sherman advanced he directed his supply lines to move forward and that the bridge over the Chattahoochee River be rebuilt. The bridge was calculated to be over 780 feet long and 90 feet high or almost twice as long as the Potomac Creek bridge which was rebuilt in 1862. At this time, the Railroad Construction Corps was its most capable and the bridge was rebuilt and in service in a remarkable four and one half days.[83] Sherman's assault on Atlanta continued until his army had almost encircled the city and severed almost all railroad lines into Atlanta. Just before being pinned in, Hood withdrew from the city and attempted to interdict the Union supply lines running from Chattanooga. Sherman at that point dedicated a force to block Hood's army and began movement to Savannah to link up with General Grant in the East. Before leaving Atlanta, he nullified the threat to his rear area and railroad line of communication by abandoning them and destroying the tracks surrounding Atlanta and for 30 miles in the direction of Chattanooga.[84]

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This second part of the campaign from Atlanta to Savannah was truly a march and unique for its absence of railroad support. Sherman had probably calculated that the railway capacity would be as much a liability as an asset and that the poor condition of Confederate track and rolling stock would only slow down his movement to the coast. Additionally, Sherman probably reasoned that if he tried to tried to keep his lines of communications linked through Chattanooga he would have to devote more of his army to countering Hood's attacks on his rear area railway stations and supply points and delaying his linkup with Grant in the East. Whatever, the full basis of Sherman's decision break from his rear rail lines of communication, he had not forgotten the importance of the railroad to sustain his enemy.

Sherman destroyed all Southern railroads along his path to the seacoast. Taking the railroad Construction Corps with is raiding column, he directed the wrecking of railroads by the heating and twisting of rails around telegraph poles. The result earned the nickname "Sherman neckties." Repair required either new rails or rerolling those so artfully tied.[85] Sherman's march had achieved surprise far more by means of logistics unorthodoxy than by strategic direction— vital as was the latter in striking a crippling blow at the Confederacy's political will, while the logistics blow destroyed the economy. It had never occurred to the Confederates that Sherman would detach himself from his main base so long as Hood was at large in his rear, or that he would make himself totally self-supporting for such a long advance. It is the first example of true strategic logistic surprise in the railway era and serves as an example for deep penetration exploits in future wars.[86]

The destruction of Southern railroads became a major theme of the Union Army 's strategy to end the war. General Grant directed his armies to conduct raids to "destroy the enemy's line of communication and military resources." Raiders wrecked foundries, rolling mills, machine shops, factories, railroad cars, and locomotives. Grant made clear that the expedition goes to destroy and not to fight battles, telling General Philip H. Sheridan to "destroy the railroad and canal in every direction, so as to be of no further use to the rebellion."[87] Grant's strategy was to confront the Confederates in as many locations as possible with cavalry forces and armies in one destructive motion.

These accounts depict the importance of the railroad to both the North and South and demonstrate how each side experimented with this innovation. They highlight that the Union railroad capability improved as the war progressed while the South's capability deteriorated over time. Additionally these accounts show that the vulnerabilities of railroads seriously diminish their strategic value. Cavalry raids could interrupt railroads operating between the bases of supplies and the fighting line.[88]

CONCLUSION; THE RAILROAD CONTRIBUTIONS AND LEGACIES OF THE CIVIL WAR

By end of the Civil War, the railroad had changed how war was executed in the United States. Compared to the Revolutionary War, the Civil War used enormous armies with many being larger than most American cities. Supplying these armies presented the same problems as feeding a city and moving them provided problems never encountered before.[89] Railroads were of paramount importance to the total war effort. The lessons from the application of the railroad to warfare are numerous. Commanders and planners who made railroads part of their overall logistics enjoyed success; those who ignored or lacked them failed. The advantages of the railroad far outweighed any challenges from its use as a strategic mobility asset or logistics enabler. The geography, speed and logistics aspect of warfare changed with the coming of the railroad and warfare would never be the same again.

Railroads provided unequaled capacity to transport troops and supplies from one region to another, but most importantly long distances away from inland waterways and population centers. The railroad's great capacity was first demonstrated in the Civil War. No other form of transport can transport so much tonnage in relation to the equipment and facilities required.[90] The huge armies of the Civil War would not have existed without railroads to provide the massive amounts of rations, ammunition, and fodder needed on a daily basis. General Sherman commented on this fact during the Atlanta Campaign when he noted, "No army dependent on wagons can operate more than a hundred miles from its base, because the teams going and coming consume the contents of the wagons." [91]

Railroads made the strategic concentration of widely dispersed military units possible. Many Civil War commanders understood the importance of this change in warfare from the very beginning of the conflict. "It can not be ignored that the construction of railroads has introduced a new and important element into war," McClellan wrote President Lincoln on August 2, 1861, "by the great facilities thus given for concentrating at particular positions large masses of troops from remote sections, and by creating new strategic points and lines of operations."[92] Throughout the war the ability or inability of railroads to provide overland strategic movement of troops and equipment would decide major engagements.

Railroads provided a renewed mission for Cavalry units. The primary purpose of Cavalry units before the Civil War was to conduct shock tactics against massed infantry. Civil War Cavalry did not often use shock tactics. Instead their standard mission was to conduct reconnaissance of enemy strength and position and to conduct raids. Both the Union and Confederates launched cavalry raids against the other's railroads targeting track, rolling stock,

and bridges.[93] A German observer, Otto Heusinger, attached to the Union Army, provided this remark on this mission and tactics change. This new type of cavalry:

> "....had the great advantage, especially in this war, of being able to be sent quickly to a fixed point without tiring a man through great exertion, and the usefulness of this arm was proved first-rate, especially in the case of Sheridan's march toward Richmond, where he destroyed railroads, bridges and canals in the enemy's rear and threw the inhabitants of the city into considerable consternation.[94]

Thus the advent of railroads served as a catalyst for change in Cavalry tactics, which in many ways set the conditions for development of doctrine normally associated with Cavalry such as search and destroy operations and raids. Vigo Roussillion, a French observer, noted that if the tactical value of the cavalry had diminished with the introduction of the breechloader, its strategic value had increased with the advent of the railroads, which was highly vulnerable to destructive raids.[95]

In addition to providing the capability to sustain, mass, and strategically move large armies the railroad provided some other insights into modern warfare. Railroads introduced extensive lines of communications and a rear area to defend. To defend a railroad line adequately, it was necessary to fortify and occupy all-important points along the line. To keep the line in good repair, it was desirable to establish large and readily available depots for materials. To destroy a railroad line required the raiding cavalry to tear up long stretches of track or the line would only be out of service temporarily.[96] General Sherman recognized importance of force protection in rear area and its high cost in manpower and resources during his movement from Chattanooga to Atlanta. It was undoubtedly his understanding of how warfare had evolved to depend on its "logistics tail" moved by railroads that caused him to severe his railroad line of communication before embarking on last movement of a modern sized force supported by wagon trains and foraging from Atlanta to Savannah.

Railroads contributed to the linear quality of modern "industrial era" warfare after the Civil War. The railroad provided the capability and capacity to project large quantities of supplies and materials along lines of communication starting at supply points in the rear and continuing to units a the front of the formation. It is interesting to note that one of the major objectives envisioned to achieve success in post "industrial era" warfare or future warfare is the ability to break from the linear support intensive warfare ushered in by the railroad. While the details of post "industrial era" warfare are still undetermined a major change envisioned is to move from large projections of logistics like that provided by the railroad to a smaller more metered insertion of logistics that is not constrained to fixed lines of communication.

Railroads provided a highly efficient land transportation capability. The manpower and fuel requirements of the railroad were miniscule to the consumption requirements of the wagon trains. Not only was the railroad more efficient than the wagon transport it was also more efficient than the combination of long haul inland water shipping and short haul wagon transport which was the norm in the years before the Civil War. Considered in isolation boat transport was a relatively efficient substitute for the iron horse. However, the absence of the railroad in the war would have required not only greater utilization of the waterways but also of wagon service. It is the additional amount of very costly wagon transportation that would have been needed for each ton of materiel leaving supply depots suggests that railroads provided a savings during both short and long distance movements.[97]

Railroads are extremely durable and can recover from enemy attacks quickly because enemy sabotage does not differ greatly from the ravages of fire, flood, landslide, earthquake, and other natural disasters, which are routine problems for the railroad industry.[98] A second noteworthy feature of the railroad when responding to enemy action or disasters, is the ability to localize the effect by directing traffic to other areas around the damaged facilities. Lastly, railroads can operate day and night in all types of weather.

Railroads provided for the creation of an organized military construction capability separate from the transportation and the railroad service. The Union Construction Corps, while not the first construction capability in the U.S. Army, clearly demonstrated how the warfare in the industrial age would be different from previous wars. Warfare in the industrial age requires the military to obtain, train and resources an expertise in engineering, construction and maintenance. The Construction Corps was an innovation with implication on foreign armies. In May 1866, on the eve of war with Austria, the Prussian War Minister created a Field Railway Section (Feldeisenbahnabteilung), which was modeled directly on the Construction Corps. The Prussians also sought out the Union Army's technical papers, documents, and books on the wartime use of railroads. Prussia clearly saw the Civil War as a testing ground for the military application of the railroad.[99] The French were also interested in the Construction Corps and in 1869, E. de Coynart wrote that the creation of a French Construction Corps was the order of the day. His warning went unheeded and France went awkwardly to war in 1870. Five years later, Railway Sections and Railway Troops were created to construct, repair, destroy, or operate railroads in war. France modeled their organization on the German Feldeisenbahnabteilung, just as the Germans had a decade earlier on the Construction Corps.[100]

Railroads provided for the creation and employment of the first armored force. This innovation foreshadowed the great railway batteries for coast defense and long range artillery

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gunning developed in later years.[101] While the development of the modern armored forces is not normally considered to be linked to Civil War armored railcars, there can be little doubt that those first developers of the tank considered the merits of Americas first armored land force.

Another major railroad innovation initiated during the Civil War was the employment of ambulance cars and hospital trains, which provided for the first large scale and long distance medical support conveyance. Hospital trains were employed during most major engagements taking the wounded away from the battlefield to the more capable hospitals normally located in the larger cities. By the end of the war, over 225,000 wounded were moved over the rails in the cars equipped for this service.[102]

Probably a little considered contribution the railroad to modern warfare is the effect its special military and private relationship would have on mobilizations of industry to support the future war efforts of the nation. While the North did operate a military railroad service, its domain was normally isolated to operation inside the war zone and then normally only on captured enemy railroads. The vast majority of railroads remained under private control throughout the war even after legislation on both sides was passed that would allow for military seizure when ever necessary. The North actively engaged and supported its railroad industry. The South was slow to recognize the importance of a strong railroad industry to its war effort and when it finally did the damage and neglect was irreversible. The North's successful mobilization of hundreds of private railroad companies by regulation and prioritization served as a model in industry and military relationships well into the future. Considering the size of the military operations there were relatively few instances of friction between the military and civilian elements once a working relationship was established. For the military, which is always confronted with the problems of relations with the civilian element, it was a valuable lesson, which showed how important civilian workers could be in prosecuting a war.

In these many ways, the railroad was one of the major innovations of the Civil War and, as a result, changed the nature and execution of the war. Since the Civil War, railroads have remained vital to the ability of the United States to project military power. Even in this day of global projection and transformation to a lighter and more mobile force, the railroad will remain an integral part of the military's and the nation's mobilization plans. In any future national defense emergency, as in all past military efforts since railroads came into being, we shall without doubt have need for the quantity and type of transport that only railroads can supply. [103]

WORD COUNT = 8843

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